

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY (Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 118949 JST	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/SE2004/002011	International filing date (day/month/year) 27-12-2004	Priority date (day/month/year) 30-12-2003
International Patent Classification (IPC) or national classification and IPC See Supplemental Box		
Applicant Telefonaktiebolaget LM Ericsson (publ) et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
 - a. ☒ (sent to the applicant and to the International Bureau) a total of 4 sheets, as follows:

☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:
- | | | |
|-------------------------------------|--------------|---|
| <input checked="" type="checkbox"/> | Box No. I | Basis of the report |
| <input type="checkbox"/> | Box No. II | Priority |
| <input type="checkbox"/> | Box No. III | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| <input type="checkbox"/> | Box No. IV | Lack of unity of invention |
| <input checked="" type="checkbox"/> | Box No. V | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/> | Box No. VI | Certain documents cited |
| <input checked="" type="checkbox"/> | Box No. VII | Certain defects in the international application |
| <input type="checkbox"/> | Box No. VIII | Certain observations on the international application |

Date of submission of the demand 21-07-2005	Date of completion of this report 30-03-2006
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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Cover sheet

International patent classification (IPC)
H01Q 13/08 (2006.01)

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SE2004/002011

Box No. I Basis of the report

1. With regard to the **language**, this report is based on:

the international application in the language in which it was filed

a translation of the international application into _____,
which is the language of a translation furnished for the purposes of:

international search (Rules 12.3(a) and 23.1(b))



publication of the international application (Rule 12.4(a))



international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

the international application as originally filed/furnished



the description:

pages 1 - 19 _____ as originally filed/furnished

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____



the claims:

pages _____ as originally filed/furnished

pages* _____ as amended (together with any statement) under Article 19

pages* 1 - 4 _____ received by this Authority on 21-02-2006

pages* _____ received by this Authority on _____



the drawings:

pages 1 - 13 _____ as originally filed/furnished

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____



a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

the description, pages _____



the claims, Nos. _____



the drawings, sheets/figs _____

the sequence listing (*specify*): _____any table(s) related to the sequence listing (*specify*): _____4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

the description, pages _____



the claims, Nos. _____



the drawings, sheets/figs _____

the sequence listing (*specify*): _____any table(s) related to the sequence listing (*specify*): _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>1-23</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-23</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-23</u>	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The invention relates to a broadband non-resonant antenna device comprising tapered slot antenna elements. The antenna element and the feeding line is formed from a single metal sheet layer without the support of a dielectric substrate, the feeding line being of the coplanar waveguide type and which intersects the tapered slot and divides it into an inner and an outer part. By the omission of the dielectric substrate, the losses in the antenna are decreased and the manufacturing process is simplified. The invention also relates to an antenna array comprising a plurality of antenna elements.

Documents cited in the International Search Report:

D1: FR 2691014 A1

D2: EP 0455493 A2

D3: Proc. of the IEEE Antennas and Propagation Int. Symp., Part 1, Vol. 1, p. 364-367

D4: Patent Abstract of Japan, abstract of JP 09246849 A

D5: Proc. of the Conference held at the Astron Institute in Dwingeloo, 12-14 April 1999, p. 49-57

D6: Proc. of the 14th Int. Conf. on Microwaves, Radar and Wireless Communications, MIKON-2002, Vol. 1, p. 222-225

The documents D1-D3 show antenna devices having tapered slot antenna elements and a coplanar waveguide feed line. The antenna elements and the feed lines are made from a single metal layer provided on one side of a substrate. The feed line intersects the tapered slot and divides the slot in two separate parts. According to D1 the end of the center conductor of the feed line is isolated from the metal layer forming the tapered slot, while according to D2 and D3 the end of the center conductor is short-circuited thereto.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

D4 and D5 show similar antenna devices, comprising a metal layer provided on a dielectric substrate and a coplanar feed line, D5 also describes an antenna array comprising a plurality of similar antenna elements.

D6 describes a tapered slot antenna device, where tapered slots are formed in the walls of a metal box and where a stripline feed is used.

The invention according to the amended claim 1 differs from the cited prior-art devices by eliminating the dielectric substrate and forming the tapered slot antenna and the feed line from a single metal sheet.

The invention as claimed therefore has novelty.

The problem to be solved by the invention is to provide an antenna device having lower loss and being easy to manufacture.

A person skilled in the art would not, using the teachings of the cited prior-art, be guided towards a solution as described in the amended claim 1, as none of the cited documents indicate or suggests a solution according to the claim.

The invention as claimed therefore show inventive step.

The invention is also considered to have industrial applicability.

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

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Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

Claim 14 is dependent on "any of the preceeding claims" although the special technical feature "...said electrical contact..." is mentioned for the first time in claim 13.

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CLAIMS

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1. A broadband non-resonant antenna device for wireless transmission of information using electromagnetic signals, comprising a metal sheet layer (2), forming a plane, with a slotline (3) that comprises a first part (3a) and a second part (3b), where the side of the second part (3b) that is the most distant from the first part (3a) transcends into a widening open-ended tapered slot (6) in the metal sheet layer (2), where the device additionally comprises a feeding line (4) in the metal sheet layer (2), which feeding line (4) comprises a feeding part (7), with a first end (7a) and a second end (7b), and gaps (8, 9) separating the feeding part (7) from the surrounding metal sheet layer (2) by a certain distance, where the slotline (3) is intersected by the feeding line (4) characterized in that the antenna device is made from a sheet of metal, forming the metal sheet layer (2).
2. Antenna device according to claim 1, characterized in that the feeding part divides the slotline (3) into the first part (3a) and the second part (3b) of the slotline (3)
3. Antenna device according to claim 1 or 2, characterized in that the first end (7a) of the feeding part (7) is connected to the metal sheet layer (2) after having intersected the slotline (3).
4. Antenna device according to any of the preceding claims, characterized in that the tapered slot (6) has an exponential form.
5. Antenna device according to any of the preceding claims, characterized in that the side of the first part (3a) of the slotline (3)

that is the most distant from the second part (3b) transcends into an essentially two-dimensional cavity (5).

6. Antenna device according to claim 5, characterized in
5 that the essentially two-dimensional cavity (5) has a circular form.

7. Antenna device according to any of the claims 1 to 4,
characterized in that the side of the first part (3a) of the slotline (3)
that is the most distant from the second part (3b) is short-circuited to the
10 metal sheet layer (2).

8. Antenna device according to any of the preceding claims,
characterized in that the first end (7a) of the feeding part (7) is
positioned past the slotline (3), with the gaps (8, 9) continuing at each of the
15 sides of the feeding part (7).

9. Antenna device according to claim 8, characterized in
that the gaps (8, 9) are joined at the first end (7a) of the feeding part (7).

20 10. Antenna device according to claim 9, characterized in
that the joining part of the gaps (8, 9), at the first end (7a) of the feeding part
(7), forms an essentially two-dimensional cavity (11).

11. Antenna device according to any of the preceding claims,
25 characterized in that the second end (7b) of the feeding part
extends to an edge (2') of the metal sheet (2).

12. Antenna device according to any of the claims 1-6,
characterized in that an external feeding (19, 20, 55) is attached to
30 the second end (7b) of the feeding part (7).

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13. Antenna device according to any of the preceding claims, characterized in that electrical contact is obtained between those ground planes (61, 62) that surround the centre conductor (7) near the position where the centre conductor (7) intersects the slotline (3).
- 5 14. Antenna device according to any of the preceding claims, characterized in that said electrical contact is obtained by means of a metal bridge (63, 63', 64).
- 10 15. A broadband non-resonant array antenna comprising a plurality of similar antenna devices (1a, 1b, 1c), for wireless transmission of information using electromagnetic signals, characterized in that at least one of the included antenna devices (1a, 1b, 1c) has the features described in any one of the claims 1-14.
- 15 16. Array antenna according to claim 15, characterized in that the antenna devices (1a, 1b, 1c) are positioned beside each other on the metal sheet layer (23).
- 20 17. Array antenna according to claim 16, characterized in that a plurality of metal sheet layers (23), comprising the antenna devices (1a, 1b, 1c) positioned beside each other, are placed in a plurality of rows (26a, 26b, 26c).
- 25 18. Array antenna according to any one of the claims 15-17, characterized in that for each included antenna device (1a'; 1a, 1b, 1c), one orthogonally arranged antenna device (1a"; 30, 31, 32) is arranged.
- 30 19. Array antenna according to any one of the claims 15-18, characterized in that the external feeding comprises at least one feeding module (19, 20, 55) of an active or a passive type connected to at least one of the antenna devices (1a, 1a', 1a", 1b, 1c, 30, 31, 32, 56, 57).

20. Array antenna according to claim 19, characterized in that the at least one feeding module (19, 20, 55) comprises a variable phase-shifter and/or power attenuators.
- 5 21. Array antenna according any one of the claims 19 or 20, characterized in that the at least one feeding module (19, 20, 55) may be connected to a control unit for power and phase control.
22. Array antenna according any one of the claims 19-21,
10 characterized in that the at least one feeding module (19, 20, 55) is electromagnetically coupled to at least one of the antenna devices (1a, 1a', 1a'', 1b, 1c, 30, 31, 32 56, 57).
23. Array antenna according any one of the claims 18-22,
15 characterized in that the at least one feeding module (19, 20, 55) is arranged to feed the at least one antenna device (1a, 1a', 1a'', 1b, 1c, 30, 31, 32, 56, 57) in such way that circular polarization is obtained.